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PROGRESS REPORTS

FROM

EXPERIMENT STATIONS

SEASON 1956-1957

NORTHERN NIGERIA

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PROGRESS REPORTS FROM EXPERIMENT STATIONS

The reports for the seasons up to and including 1950-51 were published in seasonal volumes; the following are still in print and available at 3/- per volume post free.

1923-25 (one volume), 1926-1927, 1931-32, 1934-35, 1935-36, 1942-43 and 1945-46 to 1950-51.

From 1951-52 the reports from each territory were published individually each season. A few of the 1951-52 reports are out of print, but all others are available post free at 1/- per report or 7/6d. for the seasonal set.

NORTHERN NIGERIA
PROGRESS REPORT FOR THE SEASON 1956-57

Planting Period: June to September.
Picking Period: November to March.
Close Season: April to June.

General Introduction.

BY

H. E. KING and M. A. CHOYCE

Season and General.

The season was disappointing: exceptionally poor early rains resulted in serious delay in the planting of food crops and in consequence the planting of much of the commercial cotton crop was also greatly delayed. Weather subsequent to planting was not particularly favourable and the onset of the dry season was early and abrupt.

The crop was in consequence smaller than that of last year, yields being particularly poor in the older established areas—Katsina and Sokoto. Only at Gombe was the upward trend of production maintained. There a record crop proved too much for the Gombe ginnery and part had to be transported to the newly erected ginnery at Kuru in Plateau Province.

The incidence of insect pests was, in most areas, less than that recorded for the previous season and damage by diseases was not in general particularly severe; weather must be regarded as the main cause of the low yields.

A summary of the meteorological data for Samaru is set out in Table 1. It will be seen that the total rainfall was only 36·5 inches, nearly 8 inches below the mean for the past thirty years. This low total, largely due to a serious deficiency in June, was a common feature of records from other stations. Although the table shows 3·55 inches falling in October at Samaru the whole of this was recorded over the first 8 days. Severely dry weather set in here, as elsewhere, early in the month.

Nevertheless yields on the farm at Samaru, with timely (early July) planting, did not seem to be greatly affected; the final figures were on the whole equal to, or somewhat above, those of last season. Some fields, early planted and well treated, gave very high yields indeed for Nigeria; over 1,100 lb. of seed cotton per acre were recorded in one instance.

At Daudawa also, some exceptionally high yields were recorded; a 16 acre field of second wave 26J averaged over 700 lb. of seed cotton per acre. It appears that with a higher yielding strain, timely planting and the use of fertilizers, the adverse effect of poor weather may be

TABLE 1.

SUMMARY OF METEOROLOGICAL DATA AT SAMARU UP TO 1956.

	Rainfall		*Days rain*		*Relative humidity*(1)				*Air temperature °F (screen)*				*Sunshine daily mean (hours)* (2)		*Open pan evaporation (inches)* (3)	
Month	1956	1924 -56 *Av.*	1956	1938 -56 *Av.*	1956 *a.m.*	1956 *p.m.*	1938 -56 *a.m. Av.*	1938 -56 *p.m. Av.*	1956 *Max.*	1956 *Min.*	1938 -56 *Max.*	1938 -56 *Min.*	1956	1954 -56	1956	1954 -56
January	0·00	0·00	—	0·0	17·4	14·0	30·3	13·9	84·1	57·6	87·9	57·8	9·3	9·3	7·48	7·06
February	0·28	0·06	1	0·4	30·2	16·1	28·3	12·9	84·4	54·9	88·6	57·6	9·1	9·5	6·47	7·25
March	1·32	0·41	3	1·2	49·6	27·3	37·4	16·2	94·2	61·8	91·8	60·7	7·9	8·6	7·35	8·28
April	1·76	1·26	4	3·2	51·3	26·3	56·2	26·6	94·7	68·8	96·1	67·3	8·8	7·8	7·40	7·12
May	1·73	5·24	6	10·7	60·2	33·2	74·6	46·3	95·1	67·8	97·3	71·0	9·6	8·6	7·83	7·30
June	3·97	6·31	12	12·7	72·2	54·8	82·9	59·2	94·9	69·2	91·8	70·1	8·5	8·1	6·09	5·61
July	7·65	8·86	17	16·3	79·1	68·3	87·6	68·8	88·3	66·9	88·0	68·1	5·4	5·6	4·67	4·83
August	7·63	11·77	19	20·6	87·3	74·1	89·9	73·0	82·3	65·8	83·5	67·3	3·5	4·0	3·63	4·28
September	8·61	8·80	16	16·6	77·7	64·2	86·3	65·0	79·5	65·4	81·9	66·9	6·7	6·5	4·91	5·03
October	3·55	1·46	6	4·7	50·7	38·8	77·1	45·3	84·8	65·7	84·9	66·7	9·4	8·6	6·40	5·81
November	0·00	0·05	—	0·3	29·4	20·6	43·4	21·7	87·3	62·0	89·0	65·3	10·2	10·1	6·28	6·64
December	0·00	0·00	—	0·0	27·2	22·0	30·6	16·5	90·3	59·8	90·1	60·6	9·3	9·8	6·25	6·66
Totals	36·50	44·22	84	87·1	—	—	—	—	—	—	—	—	—	—	74·76	75·87
Mean	—	—	—	—	52·7	38·3	60·4	38·8	88·3	63·8	89·2	64·9	8·1	8·0	6·23	6·32

(1) Since 1953 observations taken at 0900 hrs. and 1500 hrs. G.M.T.
Before 1953 observations taken at 0800 hrs. and 1300 hrs. G.M.T.

(2) Campbell-Stokes sunshine recorder.

(3) From sunken tank 6′ × 6′; not corrected for errors due to splash.

very substantially reduced. A common feature of the season, however, was the late arrival of the crop, whether good or bad; boll setting was very poor early in the cropping season and fruiting was, in consequence, very long drawn out compared with a normal season.

Staff, Buildings and Land.

Mr. Choyce returned from leave on 30th July, and Mr. King took leave from 18th July to 24th September 1956. Mr. Lawes proceeded on leave on 1st March 1957, and Mr. Parker on 8th March.

Mr. B. J. S. Lee, on transfer from Uganda, arrived at Lagos on 23rd February 1957 to join the plant breeding staff and assist also with climatological and crop physiology work.

Mr. M. G. Emsley left Samaru on 12th April 1957 for leave prior to resignation in order to take up a post in Trinidad.

The African staff position became even more difficult towards the end of the season, with the temporary withdrawal of three experienced men for higher training courses leading to promotion and the loss of a fourth by death. The laboratory work in particular suffered considerable delay in consequence.

Pending the erection of the proposed new buildings, laboratory accommodation remained cramped.

Some small areas of new land were put into cotton for breeding work and plant pathology.

Plant Breeding.

BY

H. E. KING and D. A. LAWES

Hybridization, Progeny Rows and Small Bulks.

The breeding work was continued on established lines with some hybridization using imported types, but the main effort still concentrated on straight reselection within the local Allen stocks.

The results of a series of replicated progeny row tests and some small bulk trials were somewhat disappointing and difficult to interpret, presumably as a result of the late season which (for the second year running) appeared to cause some reversals of behaviour of previously most promising selections.

In view of this, detailed results will not be discussed here but it can be recorded that a few types of undoubted and sustained promise, particularly as regards high seed cotton yield and high ginning percentage, emerged for larger scale tests.

It seems likely that difficulty will be experienced in advancing the lint yield much further within the Allen material without some fall in

lint length and spinning quality: there is a definite tendency for high yield to be associated with below average lint length. The failure of the line 26C/49160-23, mentioned in a number of previous reports as combining high yield and very good quality, has left a gap.

Strains Test.

The usual replicated field test at Samaru, containing a range of imported strains of various origins together with all the more promising local selections, was carried through.

Yields were good and strain differences large, but the accuracy of the comparisons, in spite of the ten replications employed, was not high.

As recorded in previous seasons, no imported type showed any real promise of competing with 26C and 26J in merit for commercial growth here. Those giving higher seed cotton yields fell away when their lower ginning percentage was taken into account.

Even types such as Punjab 268F imported solely on their reputation for yield, irrespective of spinning quality, do not stand out as really high yielders (in terms of ginned lint) at Samaru. Albar types and reselections and a number of local reselections from Uganda BP52 were likewise disappointing in yield.

District Variety Tests.

The usual series of replicated tests, sited at experiment stations throughout the cotton growing areas, was carried out. Results were more than usually erratic both in level of yield and accuracy of varietal comparisons. Conditions for establishment of a good stand of seedlings were particularly difficult at certain stations, with the result that overall stands were poor and, in addition, significant differences between strains in percentage stand appeared. At other sites, where conditions were easier, each of the eight strains showed equally good germination (as they had done also in laboratory germination tests). It would seem that, although equally viable under good conditions, there were differences in vitality of the seed.

Results from two of the sites were rendered useless on this account, while a third site, Maiduguri, had to be ruled out through severe locust damage. Yield data from the remainder still showed such wide variations in accuracy that no overall comparisons of strains could usefully be made. Figures from the more accurate tests considered alone confirmed the superiority of 26J over 26C shown in previous seasons (and also in the Seed Stocks Trial at Samaru this season—see later). Of the new selections included, none was outstanding everywhere, but one, a 26C/499 derivative, did extremely well in seed cotton yield in the two Samaru tests.

Seed Stocks Trial.

To obtain confirmation of the relative yield, ginning percentage and lint length of 26C and 26J, an additional trial was laid down this season, at Samaru only, in which two seed stocks of each strain were included using a plot size of 1/20 acre and eight replications arranged in two 4 × 4 Latin squares.

Growth was no more than reasonably good, and the yield representative of what a good cultivator might be expected to attain. The yields and lint lengths are given in Table 2. Notes made during the season on a plot by plot basis brought out clearly that the multiplication stock of 26C was superior to the commercial stock in uniformity and in resistance to jassid, and that both stocks of 26J were superior to 26C in appearance and quite satisfactorily resistant to jassid under the conditions of this experiment.

A further point concerning the difference between the two strains, not brought out by the figures for total yield in Table 2, was the greater earliness of the two 26J seed stocks. These had given 32% of their crop before the end of December while the two 26C stocks had given only 28½%.

TABLE 2.

RESULTS OF SAMARU SEED STOCKS TRIAL.

Seed stock	*Seed cotton lb. per acre*	*Gin per cent.*	*Lint lb. per acre*	*Lint as % of comm.*	*Seed weight* (2)	*Lint index* (3)	*Lint length mm.* (4)
Commercial stock (1) of Samaru 26C	670	35·7	238	100	9·5	53	33·1
Multiplication stock of Samaru 26C	680	37·0	250	105	9·6	56	33·9
First Wave 26J	735	36·1	265	111	9·3	52	34·5
Second Wave 26J	734	36·3	265	111	9·3	53	34·8
S.E.			± 11·8	± 4·9			

(1) Commercial seed from a number of ginneries mixed.
(2) Weight of 100 seeds in grams.
(3) Weight of lint per seed in mgms.
(4) Bailey halo.

Seed Multiplication.

The multiplication plots at Samaru yielded satisfactorily. Many of the larger ones were used for agronomic experiments, treatments such as manuring, cross-tying of ridges and mulching being superimposed. The layout was arranged to confound strain differences with blocks of the replicated experiment. This enabled trials to be carried out for which otherwise no land was available, and did not seriously interfere with seed production.

The early stages of seed multiplication on the Daudawa farm were very successful, yields being notably high considering the poor season in Katsina Province in general. This applied also to the first stage beyond the government farm—the stage D area of approximately 4,000 acres farmed by peasant settlers around Daudawa. This, growing the first wave of Samaru 26J, produced ample seed for the following 27,000 acre stage in Southern Katsina, plus 30 tons for issue to the Gombe seed multiplication scheme and some surplus for trials elsewhere. The good crop may be attributed in part at least to the high yielding powers of 26J.

The seed multiplication scheme in Gombe Division of Bauchi Province also produced an extremely good crop once more and provided adequate good seed of 26C for issue throughout the Gombe ginnery area and beyond.

Agronomy and Crop Physiology.

BY

H. E. KING and D. A. LAWES

Certain long term agronomic experiments, designed to elucidate the interaction of planting date with soil fertility and with time of application of nitrogenous and phosphatic fertilizers, were continued in co-operation with the agronomic staff of the Department of Agriculture.

The results in general followed those given in last season's report pp. 11-14 and will not be presented here in detail.

Consideration of past results of agronomic and other experiments has led to the belief that factors other than soil nutrients have an overriding effect on yield levels. In particular the complete failure of fertilizers to counteract the depressing effect of delay in planting is thought to be due to the limiting effect of soil texture and surface impermeability.

A number of new experiments and field observations planned to test this belief were therefore commenced. These included a series of gauges from which rainfall run-off could be measured using a range of soil surface treatments and mulches. Some preliminary results of great interest were obtained and have been made the subject of a separate report already published*. Amongst the field experiments the response of both cotton and sunflower to a heavy surface mulch of groundnut shell was remarkable. Since the amount of shell produced per acre of the groundnut crop is inadequate for the really large scale use of this

*Lawes, D. A. Preliminary report on soil-water-crop relationship at Samaru, Northern Nigeria, 1956. Emp. Cott. Gr. Rev. XXXIV, 3, July 1957.

material the results obtained must be regarded solely as a pointer to the need for further study of means of protecting the soil surface.

Cross-tying of furrows, in this season of below average rainfall, gave a 14% increase in yield of seed cotton. The ridges were at 3 feet spacing and the cross ties at 4 yard intervals.

An experiment designed to show whether an unusually heavy dressing of farmyard manure (12 tons per acre against a normal dressing for Northern Nigeria of 1 or 2 tons) would conspicuously improve soil texture was inconclusive. The growth of cotton following the ploughing in of this quantity of manure was strong to the verge of rankness, but was just about equalled by that produced by fertilizing with sulphate of ammonia and superphosphate in quantities containing comparable amounts of N and P. In neither case was there any serious waterlogging and there were no conspicuous differences in apparent soil texture and permeability to be reflected in growth or yield of the cotton. The yields were in fact almost equal at a level of approximately 1,200 lb. seed cotton per acre.

The unusually low rainfall and low level of pest incidence both render this result of doubtful utility. Such heavy manuring can, in some circumstances, result in a grossly rank, unfruitful, diseased and insect-ridden crop.

Plant Pathology.

BY

H. M. PARKER

Introduction.

The three main lines of investigation into bacterial blight this season were the relative importance of the methods of survival from one season to the next, varietal reactions to infection and the effect of seed treatment.

In general, plots and multiplication areas at Samaru and Daudawa were only lightly attacked where the seed had been treated with Agrosan GN5. Plots sown with untreated seed showed moderate to severe seedling blight early on, followed by plentiful angular leaf spot and vein blight, and towards the end of the rains more and more frequent blackarm (stem and branch lesions). After the rains, boll and pedicel lesions were very few in number but large in size.

At Daudawa, however, a series of plots planted in mid June with disinfected seed showed severe damage, with many fruiting branches killed, though later planted plots adjacent showed only moderate attack and there was no apparent spread to other cotton on the farm.

Alternaria, Ramularia and *Rhizoctonia* caused only slight damage in general; *Fusarium* and *Verticillium* wilts, virus leafcurl and *Meloidogyne* rootknot could not be found.

Survival of X. malvacearum.

(*a*) *Survival in trash.*—It is uncertain how much *X. malvacearum* survives in cotton trash over the dry season, and how far this might nullify the effect of seed treatment.

An experiment was, therefore, laid down to test disinfected and undisinfected samples of eight different seed stocks, each planted with and without the addition to the planting hill of a small handful of infected cotton plant trash. This infected trash had been collected from plots carrying a diseased crop in the previous season and had been stored under cover.

To reduce the risk of cross contamination at planting and to delay the spread from infected seedlings, a double split plot design was used, with trashing versus no trashing in main plots, disinfection versus no disinfection in sub-plots and the eight seed stocks in sub sub-plots.

Counts of diseased seedlings at about five weeks from planting indicated that the seed stocks chosen had covered a wide range of seed-borne infection. The mean percentages shown by plots planted with undisinfected seed and without the addition of trash ranged from 1% for BAR 7/8.1 to 72% for one stock of 26C taken from a heavily infected crop.

The use of Agrosan GN5 as a seed dressing at 1 : 150 was shown to be very highly effective regardless of the level of the original seed-borne infection in the absence of added trash. Seedling infection was reduced to between 0·06% and 1·5%.

The effect of adding trash was dependent not only on the presence or absence of Agrosan dressing on the seed, but also on the level of original seed-borne infection. Thus if original infection was low and the seed was not dressed, then the addition of trash gave a small increase in infection. If infection was already at a moderate level, then trash apparently added nothing. If infection was at a high level, then trash markedly reduced it.

In the presence of Agrosan the effect of trash was to raise the level of infection markedly when it had originally been low, and to restore it to a quite substantial level again when it had been moderate or high before the use of Agrosan.

The addition of trash had effects other than merely presenting a source of infection: it appreciably delayed the emergence of the seedlings, which may be the explanation of its action in reducing the effect of high initial seed-borne infection. However, it is not easy to explain how it could raise the originally low level more in the presence of Agrosan than in its absence.

This trial demonstrated the potential hazard of disease-carrying trash. A second and smaller trial, using the more susceptible variety MU8A, compared trash stored in drums with trash from the same field, but exposed to weathering under 1″ mesh wire netting from 22nd May, just before the first rains, to the day of planting, 24th July. The planting seed had been acid-delinted and stored for 12 months in a screw-stoppered jar. It should, therefore, have been free from blight contamination but would not be protected from seedling infection. The same field was used, with 7 ridges per plot, in four replications of three treatments each (weathered trash, stored trash, no trash).

Germination was more even than in the first trial, though trashing still delayed full emergence by a day or two. At 11 days no blight had appeared; at 3 weeks there was a significant increase for stored trash (2·5%) over control (0·08%), with weathered trash giving 1·2% infection. A count on 28th August of plants with angular leaf spot plus vein blight showed a very highly significant increase for stored debris—43·5% as against 0·66% for weathered debris and 1·2% for control. Figures on 2nd October of plants with vein blight in the three central rows were 36·9% stored, 4·0% weathered and 5·7% control. Final yields from the 3 central rows showed no significant differences, though the stored trash treatment yielded 16% less than control or weathered trash.

A tentative inference from one season's work is that trash protected from the main effects of weathering may lead to much seedling blight, even after successful seed disinfection. Full exposure to weathering eliminates this hazard; if rain is the main factor involved, sterilization of the pathogen might be even more assured in wetter seasons, since, for the period of exposure, this was the driest season for the last 32 years.

(*b*) *Survival on or in the seed.*—An unreplicated observation plot was planted on 14th July with 42 samples of undisinfected and undelinted seed, from early and late pickings from 20 cotton markets, and early pickings from 2 others. Planting was completely randomized, with 6″ spacing on single 12 yard ridges. Blight appeared first 19 days after planting and its incidence at 26 days ranged from nil to 46%. A general tendency to higher incidence for seed from early pickings persisted in counts of seedling blight a week later and in angular leaf spot plus vein blight counts at 5 weeks from planting, after which row to row spread obscured the picture.

Varietal Reactions to Bacterial Blight.

Eight varieties were planted in simple randomized blocks, in eight replications of eight three-row plots, at two sites. At the first, following three successive cotton crops out of bush, both the seed and

later the stems were inoculated, the trial serving to test methods of inoculation for subsequent use in large scale cotton breeding at Samaru. At the second site, on clean land half a mile away, there was no inoculation, as it was intended to act as an observational control.

The eight varieties, all of which had suffered a very slight attack of bacterial blight in 1955-56, comprised second wave 26J from Daudawa, and seven varieties from a trial at Samaru, 26C/49130-21, Mai Inchi Allen, 26I/25, BAR 7/8.2 (B_2B_3), Albar 51 (474), MU8A DBCP, and BP52.5MB.

Seed was acid-delinted throughout, that for the inoculated site being soaked on 17th July 1956 in a suspension of *X. malvacearum** and then dried. This site was planted on 20th July, and the non-inoculated site next day, and germination in both was good.

The non-inoculated site virtually escaped infection, few symptoms appearing until the end of September, when a light attack became general. Many plants were diseased, though still lightly, 3 weeks after the rains ended on 8th October. Albar 51 showed relative susceptibility similar to the other Allen varieties in all phases, while BAR 7/8.2 was highly resistant.

Bacterial blight soon attacked the inoculated site heavily. At 12 days, 26J was very highly significantly more diseased (22·8%) than any other (0·1% to 2·7%). Nine days later, 75·3% of 26J seedlings were blighted, compared with 29·4% for BP52, the next most heavily attacked, 19·2% for Albar 51, and 0·7% for BAR 7/8.2. A similar trend was revealed by grading cotyledon lesions four days later, and by recording the incidence of leaf symptoms (angular leaf spot plus vein blight) at one month from planting.

A record of vein blighted plants after thinning to two plants per stand showed a change in order with 31·4% infection in 26J, 44·2% in BP52 and 50·0% in MU8A. Grading for natural angular leaf spot size in mid September showed that all varieties were very susceptible, including Albar 51 and BAR 7/8.2, though in the latter variety the lesions were few, and confined to the lowest leaves. At this time (14th September) one plant per stand in the central row of the three row plots was stem-inoculated by needleprick*, and on 23rd to 26th October a comparative vein blight count was made. For all 8 varieties, stem-inoculated plants showed a significant increase; the symptoms were almost certainly not derived from rain-splash infections, and consisted mainly of a fanwise spread of vein blight symptoms from the petiolar union outwards, often extending to the tips. The highest incidence of vein blight after stem-inoculation was on MU8A, with BP52 very high, 26C/49130-21 high, 26J, Mai Inchi Allen, 26I/25 and Albar 51 moderate and not differing significantly; and BAR 7/8.2

*G. M. Wickens. E.C.G.C. Research Memoir No. 15, 1953.

very highly significantly lower than any other. (The trend for plants not stem-inoculated was broadly similar, but at a lower level of incidence).

Stem reactions were graded on 9th-19th November; as lesions other than those at the points of inoculation were included, a background assessment of uninoculated plants was also made. All varieties suffered highly significantly greater damage from stem-inoculation, with 26J suffering least increase and MU8A most; the other varieties did not differ significantly between themselves.

During October 3,000 bolls of all 8 varieties were tagged at flowering, and the 550 survivors were inoculated by a multi-needleprick method in the second week of November. Over 1,800 2-3 day old bolls were sprayed with bacterial suspension at the end of October, and in mid November 1,200 were inoculated with a soft brush dipped in suspension. No boll spotting attributable to inoculation had been seen by 5th-7th December.

Yields showed no certain correlation with disease. The non-inoculated site averaged 605 lb. seed cotton per acre, compared with 331 lb. on the inoculated site.

Conclusions.—The initial attack suffered by 26J was by far the greatest, and its disease rating was the highest. This position persisted into the leaf phase, though four other varieties were as high in their rating. Later, 26J showed an increasing tolerance to the disease and its stem resistance was the highest. As the seed came from a different source from that of the other seven varieties, however, it is not certain that it is a true varietal difference, and acid-delinting may have had a differential effect on it.

It is of interest to note that Albar 51 (474), selected at Namulonge for its high level of resistance to bacterial blight there, is no more resistant at Samaru than any other Allen derivative. MU8A and BP52 started at a level similar to the Nigerian strains, but showed an increasing susceptibility with age of plant, judging by vein blight and stem lesions. BAR 7/8.2 was consistent in its high resistance to all phases except size of angular leaf spot, which was only slightly less on average than all others, though the number of lesions was distinctly fewer on this variety.

The high incidence of vein blight after rains had ceased provides ample evidence of internal vascular spread of the disease, since rain-splash infections could not occur on leaves that developed after the last rain fell.

The techniques of the inoculation varied in their response. Seed inoculation was effective, but was probably modified by the previous acid-delinting of the seed (done in order to reduce the seed to a common low level of natural infection). Stem inoculation was much

less spectacular, possibly due to higher stem resistance induced by the environment—the plants were extremely woody, and it was probably more difficult for stem lesions to develop on them. The observed lesions were almost entirely black necrotic depressions; some showed incipient callusing, and on rare occasions early in their formation water soaking at the margins.

Leaf inoculation by spraying was not tried, as natural infections were plentiful and adequate for disease rating. Boll inoculations were disappointing, but as they were all performed in harmattan conditions after rains had ceased, their failure might be explained by the drying out of bacteria before infection could occur. Such few natural infections as occurred might either have resulted from internal spread or have started during the rains and passed unnoticed.

Effect of Seed Treatment.

Disinfectants and inoculated seed.—Stock 26C was acid-delinted, and half was inoculated by 3 hours' soaking in *X. malvacearum* suspension. Each half was then subjected to seed disinfection and planted with controls on 25th July. Germination was good.

On 16th August seedling blight incidence on inoculated plots was between 59% and 73%; uninoculated plots showed 1·6% to 5·7% incidence, and controls 3·0%. Evidently sufficient bacteria penetrated deeply enough into the seed to remain largely unaffected by any further treatment, even with organo-mercurials; a possible explanation of the occasional blighted seedlings produced by seed from a diseased crop even after disinfection.

This experiment was discontinued on noting these results and a further observation plot, randomized but unreplicated, was laid down, using 26J seed, naturally and heavily contaminated. Four lots of seed, raw, machine-delinted once, machine-delinted twice, and acid-delinted, were treated with Agrosan GN5, YF 4303, or YF 4304, at 1:150 respectively, or left untreated as control, and planted on 20th August. (The YF 4303 and YF 4304 compounds were similar to Agrosan but containing a deeper dye, rhodamine.)

Germination at 12 days was good; subsequent blight counts at 3 weeks showed little difference between the disinfected plots (nil—6%), including acid-delinting, while non-disinfected plots yielded 33—41% diseased seedlings. These differences persisted a week later, but were gradually confused by secondary spread afterwards.

This unreplicated plot gave the preliminary indication that the modified disinfectants did not noticeably affect either germination or the effectiveness of the bactericide in the presence of either of the two strengths of added rhodamine.

Seed treatments and incidence of bacterial blight.—This experiment, using 26J seed from a heavily attacked crop, was designed to demonstrate whether seed disinfection with Agrosan GN5 was affected by the state of the seed, the site, or the time of planting.

Plots at four different sites were planted at a succession of approximately one week intervals. Four states of seed (raw, machine-delinted once, twice, and acid-delinted) were each disinfected with Agrosan GN5 at 1:150, or left untreated, making eight treatments, which were replicated eight times in randomized blocks at each site.

Site 1 was planted on 14th July 1956, on land last in cotton in 1949, with groundnuts alternating with guinea corn, maize and cassava since then; the soil was a heavy clay. Site 2 was planted on 9th July, after grass fallow in 1952, cotton in 1953 and 1954, and sunflower in 1955; the soil was a coarse, heavy silt. Site 3, planted on 30th July near a line of mahogany trees, was on an old rotation experiment site, involving cotton, guinea corn, groundnuts and fallow. The soil was a heavy silt in a hollow liable to waterlogging. Site 4, planted on 25th July, had carried millet and sunflower in 1953, grazed dub grass (*Cynodon dactylon*) in 1954, and a cotton insecticide trial in 1955; the soil was a heavy clay with gravel.

Germination at 11-13 days was generally good; treatments did not differ in general vigour of seedlings; at this time a few blighted seedlings were seen in non-disinfected plots in Site 4 only.

Counts of blighted seedlings at 16-32 days from planting showed a high level of blight infection in non-disinfected and non-acid-delinted plots. Acid-delinting alone reduced incidence to nil in three of the sites, but a few plants were diseased in Site 2, the first to be planted.

Sites 1 and 2 were thinned to 18″ spacing at 2 plants per stand at the end of August; Site 3 was left untouched, and not thinned, weeded or manured, while Site 4 was not thinned, but was weeded and manured with a standard application of fertilisers as in Sites 1 and 2. Site 3 remained stunted, its condition undoubtedly being aggravated by the standing water.

In a count of plants with vein blight in mid September, differences between treatments were reduced, largely because of lower percentages in treatments that had earlier yielded high levels of blight incidence. Site 4 tended to have about half or less the number of vein-blighted plants in the non-disinfected and non-acid-delinted treatments compared with Sites 1 to 3. The proportionate damage was greatest in Site 3, while Site 2 was much more heavily attacked than Site 1, though the numbers attacked were similar. This tendency persisted until after rains had ceased, in October, when stem lesions and vein blight predominated.

Finally, no correlation of yield could be obtained with disease incidence or seed state, but Sites 1 and 2 yielded 534 and 644 lb. per

acre respectively, while Site 3 yielded 29 lb. and Site 4 293 lb. Treatments differed significantly only in Site 1, where raw and machine-delinted twice, both non-disinfected, yielded significantly lower than acid-delinted and machine-delinted once, both non-disinfected.

To summarise: factors such as state of seed, time of planting and differences in site did not impair the efficiency of seed disinfection as reflected by disease incidence at seedling and young plant stages; acid-delinting was as efficient as Agrosan GN5 in this respect, and subsequent treatment of plants and spread of blight overrode the effects of disease incidence on final yield.

Examination of Bolls for Internal Bacterial Blight Incidence.

Five hundred full size green bolls of 26C and 26J were examined for evidence of lint discolouration by *X. malvacearum*. The majority of bolls were quite clean in all loculi; most of those which were discoloured were affected by bollworm damage and accompanying saprophytic infection of the lint. Only one was definitely contaminated by *X. malvacearum*.

Bacterial Blight Incidence at Daudawa and Other Centres.

Supervision of the disinfection of seed at the multiplication farm at Daudawa and associated centres was made at intervals during March 1956. About 270 tons were handled, at a total estimated cost of under 1/- per acre of disinfected seed sown, using hand churns and local unskilled labour with two or three experienced overseers in charge.

Areas sown with this seed were only lightly attacked by bacterial blight.

Cotton Entomology.

BY

M. A. CHOYCE and M. G. EMSLEY

Routine records of insect pest incidence in the main (northern) cotton growing areas and the Riverain or Middle Belt region were continued. In the Riverain provinces, cotton stainers as well as bollworms were an important factor in reducing yields, and at Mokwa it was found that three generations occurred within the crop during the season.

Trials of insecticides were continued at Samaru and started at Mokwa, where the importance of insect control measures would appear to be very much greater than in the more northern areas.

At Samaru, applications of insecticide to cotton again resulted in uneconomic yield increases, but at Mokwa control of the primary invasion of stainers was followed by yield increases from June sowings of over 1,000 lb. seed cotton per acre. Further investigations into the economic use of insecticides at this station are proceeding.

A technique for sweeping and counting the number of mirids in a cotton field was developed, and it was shown that *Campylomma* populations of the order of 150,000 per acre were present during early October.

Insect Pests.

BY

M. G. EMSLEY

Bollworms.

Bollworms of all species were less common in the crop than last year. The figures in Table 3 are comparative and show the numbers of bollworms collected in fortnightly samples from 10 ridges of 10 yards throughout the season.

An examination of seed cotton samples from various markets also showed a reduction in the numbers of pink bollworms (Table 4).

Table 3.

Seasonal totals of bollworms from crop samples at various stations.

Station	*Red bollworm*	*Spiny bollworm*	*Pink bollworm*	*American bollworm*	*False codling moth*	*Not identified*
Samaru	82	6	18	0	0	0
Gombe	129	21	6	1	0	0
Kontagora	230	95	17	10	0	0
Mokwa	93	86	22	12	14	0
Shendam	29	57	53	2	3	2
Total	563	265	116	25	17	2

Table 4.

Pink bollworms found in seed cotton samples from cotton markets.

N.A. grade	*No. of samples*	*Larvae inside seed*		*Larvae outside seed*		*Totals*		
		Living	*Dead*	*Living*	*Dead*	*Living*	*Dead*	*L & D*
I	29	33	34	1	2	34	36	70
II	35	19	16	5	2	24	18	42
III	24	11	6	1	2	12	8	20
Total	88	63	56	7	6	70	62	132
Number of larvae per 10 lb. sample 1956-57						8·6	7·7	16·3
Number of larvae per 10 lb. sample 1955-56						7·1	18·4	25·4

Mirids.

Using a sampling technique described elsewhere*, the population of mirids on the investigation plot of cotton at Samaru was determined with reasonable accuracy.

The abundance and names of genera collected are shown in Table 5, which also includes data from Mokwa and Shendam. At Samaru, *Campylomma* A is the most common species, whereas at Shendam and Mokwa species B is more abundant.

Specimens of *Campylomma* A caught during September and October contained gravid ovaries, and oviposition occurred during early and mid October. The population of nymphs reached its peak during late October and a further generation of adults was produced in November. From the population curve it seems that the life cycle of this species from adult to adult takes about 5 weeks. Species B apparently does not breed on cotton.

Campylomma spp., *Lygus, Eurystylus, Stenotus* and other genera all occur on cereal crops during heading. *Campylomma* also breeds very commonly on *Veronica pauciflora* Less and *Ethulia conyzoides* Linn., both very common plants which frequently grow between cotton ridges when weeding has been neglected.

Preliminary observations on the feeding habits of insects in captivity show that all three species of *Campylomma* feed upon the growing point and on the undersides of young leaves. During feeding the leaf hairs are grasped by the tarsi, and the stylets, after an examination of the surface with the tip of the rostrum, are embedded in the tissue. The stylets are retained in position for about five seconds, and then withdrawn and re-inserted a little further away. There is no visible motion of the stylets whilst embedded. The feeding of *Stenotus* and *Eurystylus* on leaf tissue is similar except that the stylets may remain embedded for two or three minutes. *Lygus* moves its stylets up and down within the tissue of the growing point or leaf.

Crop Records.

Flower-tagging records were continued at Samaru, Gombe, Kontagora, Shendam and Mokwa throughout the season. These records are being accumulated for analysis over a period of years.

*Emsley, M. G. A coarse method of determining mirid populations in the field. Emp. Cott. Gr. Rev., XXXIV, 3, July 1957.

TABLE 5.

MIRIDS, IN 1,000's PER ACRE, SWEPT OFF SAMARU MIRID INVESTIGATION PLOT DURING 1956-57, AND FROM COTTON AT MOKWA AND SHENDAM.

Date swept	*Samaru*										*Mokwa*		*Shendam*
	6/9	24/9	4/10	11/10	25/10	8/11	12/11	23/11	7/12	6/1	31/10	4/12	18/10
Campylomma sp. A	<10	122	149	60	9·5	53	58	5	3·5	0·2	1·0	0·4	2·4
Campylomma sp. B	< 4	52	20	4·5	1	0	0	0	0	0	9·6	0·8	16
Campylomma sp. C	—	0·2	0·3	0	0·1	0	0	0·1	0	0	0	0	0·2
Lygus vosseleri	—	3·2	1·0	2·9	1·0	0·1	0·1	0·1	0	0	1·0	0	0·9
Lygus spp.	—	0·5	0·4	0·1	0	0	0	0	0	0	0	0	0·2
Eurystylus sp.	—	0·2	0	0	0	0	0	0	0	0	0·2	0	0
Stenotus sp.	—	0·3	0·1	0·3	0·1	0·0	0·2	0	0	0	0·2	0	0
Psallus sp.	—	1·0	1·0	0·1	0·1	0	0	0	0	0	0	0	0
Camptobrochis sp.	—	2·8	3·4	3·0	0·1	1·1	2·7	0·1	2·0	0	0·2	0	1·9
Creontiades sp.	—	0·0	0·0	0·1	0·0	0	0	0	0	0	0	0	0·1
Others	—	1·2	0·1	1·2	0·5	0	0·1	0·3	0	0	0·8	0	1·7

Insecticide Trials.

BY

M. A. CHOYCE

Samaru.

In a date-of-sowing trial there were four replications of twenty plots, each 3 × 12 yards, sown serially with cotton at intervals of four days over a period extending from mid June to the end of August. On two replications, sowings up to mid July were sprayed at weekly intervals from 21st August to 20th November, the later sown plots being included in the spraying programme as the plants became about twelve inches high. The spray consisted of a mixture of DDT and gamma BHC applied at the rate of 2 lb. and 0·6 lb. per acre respectively.

Germination of some of the earliest sown plots was irregular owing to lack of rain, and growth over the whole experiment was poor. Analysis of the final yields (Table 6) showed that sowing date had an extremely marked effect on yield, whether insecticide was applied or not.

Table 6.

Serial sowing date of cotton, with and without application of insecticide, Samaru, 1956-57.

Sowing date	*Yields of seed cotton in lb. per acre*		
	Unsprayed	*Sprayed*	*Difference*
15th June to 30th June	277	391	114
1st July to 15th July	252	438	186
16th July to 31st July	248	319	71
1st August to 15th August	87	182	95
16th August to 31st August	13	31	18

Yield increases of a similar order were obtained in a trial comparing the effect of endrin with that of DDT/BHC (Table 7). Five applications of insecticide were made at weekly intervals from 6th October to 2nd November, on cotton sown on 12th July.

Table 7.

Insecticide trial on cotton, Samaru, 1956-57.

Treatment	*Yield of seed cotton in lb./acre*
DDT, 2 lb./acre + g. BHC, 0·6 lb./acre	552
Endrin, 0·4 lb./acre	520
Control	403
	S.E. ± 36

The occurrence of plants with distorted roots was noted in the Progress Report for 1955-56. This year it was found that the addition of 0·5 gm. of Agrocide 3 (containing 0·65% gamma BHC) to the

planting holes of raw 26C had no effect on the percentage of damaged roots. In this experiment the cotton was planted on 9th July, and about four-fifths of the plants in treated and untreated plots had normal roots when uprooted in November. The insecticide had no effect on germination, plant height or on the incidence of bacterial blight.

Kontagora.

Following on the experiments carried out at this station during the past two years, it was shown that a series of 4 sprays applied during September and early October gave higher yields than a similar series of sprays applied during October and early November (Table 8).

TABLE 8.

INSECTICIDE TRIALS, KONTAGORA, 1956-57.

(a) Layout: 6 replications of 2 plots, each 1/18 acre, plots split for two sowing dates.

(b) Sowing dates: 15th June and 3rd July.

(c) Treatments: 1. 2 lb. DDT plus 0·6 lb. gamma BHC per acre, as emulsion, applied at 54 gallons per acre. 2. Control.

(d) Dates of application:
Trial A: on 3rd, 17th September, 1st and 15th October.
Trial B: on 1st, 15th, 29th October and 12th November.

(e) Results: Yields in lb. seed cotton per acre.

	Sowing date: 15th June		*Sowing date: 3rd July*	
	Sprayed	*Control*	*Sprayed*	*Control*
Trial A	583	182	410	146
Trial B	204	111	167	79

Mokwa.

The relatively small increases in yield obtained at Samaru are in marked contrast to the results obtained at Mokwa, and reported elsewhere*. At Mokwa the cotton stainer is largely responsible for the low yields and poor quality of cotton obtained. During 1956 two generations of adults followed the initial invasion into the crop during September and early October.

In a date-of-sowing trial, which included cotton sown at 3-day intervals from June to September, the earliest sown plots were sprayed at 2-week intervals from 31st July to 20th November, with additional applications during October. Later sown plots were included in the spraying programme as they became about twelve inches high. The spray mixture consisted of DDT and gamma BHC applied at rates of 2·4 lb. and 0·7 lb. per acre respectively.

*Choyce, M. A. Insecticide trials in Northern Nigeria. Paper presented at the West African Cotton Research Conference, Samaru, Zaria, November 1957. (In press).

The height of the June sown cotton averaged about five feet, more than twice that of the July sown cotton. Good control of stainers was achieved in the sprayed blocks and little breeding occurred. Examination during October of cotton sown during June showed that the sprayed plots carried 55% more bolls than the unsprayed plots, and that the number of bolls with internal stainer damage was reduced from 65% to 38%. A summary of the yields obtained is given in Table 9.

Table 9.

Date-of-sowing observation trial on cotton, Mokwa, 1956-57.

Sowing date	*Yields in lb. seed cotton per acre*		*Per cent increase*
	Unsprayed plots	*Sprayed plots*	
During June	455	1,483	226
During July	371	722	95
During August	209	241	15
During September	129	128	0

Table 10.

Mokwa, 1956-57.

Field	1st pick	2nd pick	3rd pick	4th pick	5th pick	Total
			Seed cotton lb. per acre			
J.6	131	91	12	9	43	285
J.7	163	86	23	15	44	331
J.8	292	116	29	36	105	577
J.9	33	12	12	124	142	323
			% clean cotton			
J.6	85	83	57	45	72	80
J.7	80	87	50	27	80	77
J.8	73	82	43	52	73	72
J.9	43	21	28	86	92	80

Notes

Field J.6.—6·9 acres—sown 23rd-28th July—received approx. 8 lb. cotton dust (10% DDT, 3% BHC) per acre on 6/10/56, 15/10/56 and 22/10/56.

Field J.7.—6·8 acres—sown 20th-21st July—received 1·5 lb. DDT and 0·4 lb. BHC per acre as low volume spray of 9 gallons per acre on 4/10/56 and 12/10/56.

Field J.8.—5·5 acres—sown 16th-17th July—received similar spray on 3/10/56 and 11/10/56.

Field J.9.—6·1 acres—sown 13th-14th July—received no insecticide treatment.

Trials with a tractor mounted spraying machine during September and early October in 5-acre fields showed that the tractor could cause considerable damage to early sown cotton. The results of spraying

and dusting various fields of cotton are shown in Table 10. One of the more obvious effects of the insecticide was the production of a much larger early crop of cotton.

As in the date-of-sowing trial, stainers entered the cotton during September and early October, and further generations of adults were produced in November-December and towards the end of January.

The comparatively low yields obtained from these large scale applications of insecticide are to some extent due to late sowing of the crop. The little cotton that was obtained from the untreated field during November and December contained a high proportion of stained lint.

In a trial to determine whether Rama (*Hibiscus cannabinus*) would act as a trap crop for stainers when interplanted with cotton, the Rama was sown in mid June and the cotton in mid July. Both crops were flowering in September and October, when the primary invasion of stainers occurred. Although the Rama attracted a higher population of stainers than the cotton, it was clear that it did not prevent them from moving on to the cotton.

Shendam.

A dusting trial at Lowlands Experimental Farm, Shendam, gave unsatisfactory results, and is to be repeated. Cotton stainers are numerous in this area and it is probable that control will give substantial increases in yield.

Appendix.

Origin and Main Characteristics of Cotton Strains Mentioned in this Report.

Allen or Nigerian Allen	"Allen's Long Staple", together with a number of contemporaneous strains of American Upland origin, was introduced into N. Nigeria in 1912 from East Africa. The present "Allen" is the result of growing the produce of this introduction successively for some 45 generations, exposed to admixture with other strains under trial and with the locally grown *Gossypium hirsutum* var. *punctatum*. Its present staple length is a bare 1" on universal standards.
Mai Inchi Allen	The commercial stock of Allen being grown in Mai Inchi ginnery area (Western Sokoto Province) in 1951-52 prior to the replacement of Allen by Samaru 26C. Since maintained at Samaru as a representative Allen stock.
Samaru 26C	A selection from Allen originating from work commenced in 1931 and emerging as a recognised improved strain in 1939. Notable for its higher yield, higher ginning percentage and relative freedom from "nep". 26C/47 etc. refer to single plant selections made in 1947.

26J	A derivative of 26C obtained by straight reselection commenced in 1947, being material from the line 26C/479-25. Higher yielding and earlier cropping than 26C, with higher spinning quality.
26I/25	26I was a sister strain of 26C dating back to 1938; 26I/25 is a recent derivative.

Imported Types (obtained for trial or use in breeding work).

Uganda BP52	A high quality strain from Uganda.
BAR 7/8.1 and 2	Sudan strains bred from SP84, which was a Uganda derivative of Parnell's U4.
Punjab 268F	A strain of American Upland giving high yields in the Punjab.
MU8A	A Malwa Upland strain from India; early and prolific but of low ginning percentage and quality.
Albar 51(474)	A blackarm resistant selection from Allen, made in Uganda in 1951.

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